

Appln. No. 10/617,243
Amendment dated March 30, 2005
Reply to Office Action of February 4, 2005

Amendments to the Claims:

Please cancel claims 1-31 and add new claims 32-45 as follows. The following listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

Claims 1-31: Cancelled.

Claim 32 (New). A color image forming method using microcapsule toner which includes a plurality of larger microcapsules each of which contains a plurality of kinds of smaller microcapsules dispersed therein, the plurality
5 of kinds of smaller microcapsules being different in at least one of outer diameter, shell thickness and material so as to be broken by ultrasonic waves of different resonant frequencies respectively, each smaller microcapsule containing an air bubble and having a protective wall breakable with an ultrasonic wave of
10 a corresponding predetermined resonant frequency, each smaller microcapsule containing inside its protective wall one of two reacting substances that react with each other when mixed to thereby cause a coloring reaction and the other of the two

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reacting substances being disposed outside the protective wall,

15 the method comprising the steps of:

forming a toner image on an image carrier by applying the microcapsule toner to the image carrier in accordance with ORed items of image information about respective colors or forming a toner image pattern on the image carrier depending on the ORed

20 items of the image information about the respective colors and then applying the microcapsule toner to the toner image pattern to thereby form a toner image;

transferring the toner image, formed on the image carrier, directly or through an intermediate transfer medium to paper;

25 irradiating the toner image applied to the image carrier with ultrasonic waves of different predetermined resonant frequencies corresponding to respective color component items of the image information, the ultrasonic waves being focused within a width of one pixel in a primary scan direction, between the
30 time when the toner image was formed on the image carrier and the time when the toner image was transferred to the paper such that the protective wall of relevant ones of the plurality of kinds of smaller microcapsules of the toner image is broken by the ultrasonic waves of the predetermined resonant frequencies to

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35 thereby cause the two reacting substances to mix and react with each other to thereby color the toner image; and

fixing the colored toner image to the paper whereby a color image based upon the toner image is formed on the paper.

Claim 33 (New). A color image forming method using microcapsule toner that includes a plurality of larger microcapsules each of which contains a plurality of kinds of smaller microcapsules dispersed therein, the plurality of kinds
5 of smaller microcapsules being different in at least one of outer diameter, shell thickness and material so as to be broken by ultrasonic waves of different resonant frequencies respectively, each smaller microcapsule containing an air bubble and having a protective wall breakable with an ultrasonic wave having a
10 corresponding predetermined resonant frequency, each smaller microcapsule containing one of two reacting substances that react with each other when mixed to thereby cause a coloring reaction and the other of the two reacting substances being disposed outside the protective wall thereof, the method comprising the
15 steps of:

electrically charging the image carrier to a predetermined voltage level;

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forming a static latent image of a voltage level pattern in
accordance with ORed items of image information about respective
20 colors on the image carrier charged in the charging step;

applying the microcapsule toner to the latent image formed
on the image carrier to form a toner image;

irradiating the toner image formed on the image carrier with
ultrasonic waves of different predetermined resonant frequencies
25 corresponding to respective color component items of the image
information, the ultrasonic waves being focused within a width of
one pixel in a primary scan direction, to break the protective
wall of relevant ones of the plurality of kinds of smaller
microcapsules of the toner image such that the reacting
30 substances mix and react with each other to thereby color the
toner image;

transferring the colored toner image on the image carrier
directly or through an intermediate medium to paper; and

fixing the transferred toner image to the paper whereby a
35 colored image based upon the colored toner is formed on the
paper.

Claim 34 (New). A color image forming method using
microcapsule toner which includes a plurality of larger

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microcapsules each of which contains a plurality of kinds of
smaller microcapsules dispersed therein, the plurality of kinds
5 of smaller microcapsules being different in at least one of outer
diameter, shell thickness and material so as to be broken by
ultrasonic waves of different resonant frequencies respectively,
each smaller microcapsule containing an air bubble and having a
protective wall breakable with an ultrasonic wave of a
10 corresponding predetermined resonant frequency, each smaller
microcapsule containing inside its protective wall one of two
reacting substances that react with each other when mixed to
thereby cause a coloring reaction and the other of the two
reacting substances being disposed outside the protective wall,
15 the method comprising the steps of:

electrically charging the image carrier to a predetermined
voltage level;

forming a static latent image of a voltage level pattern in
accordance with ORed items of image information about respective
20 colors on the image carrier charged in the charging step;

applying the microcapsule toner to the latent image formed
on the image carrier to thereby form a toner image;

transferring the toner image formed on the image carrier in
the applying step to an intermediate transfer medium;

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25 irradiating the toner image transferred to the intermediate
transfer medium with ultrasonic waves of different predetermined
resonant frequencies corresponding to respective color component
items of the image information, the ultrasonic waves being
focused within a width of one pixel in a primary scan direction,
30 to break the protective wall of relevant ones of the plurality of
kinds of smaller microcapsules of the toner image such that the
reacting substances mix and react with each other to thereby
color the toner image;

transferring the colored toner directly or through an
35 intermediate medium to paper; and

fixing the transferred toner image to the paper whereby a
color image based upon the colored toner is formed on the paper.

Claim 35 (New). A color image forming apparatus using
microcapsule toner which includes a plurality of larger
microcapsules each of which contains a plurality of kinds of
smaller microcapsules dispersed therein, the plurality of kinds
5 of smaller microcapsules being different in at least one of outer
diameter, shell thickness and material so as to be broken by
ultrasonic waves of different resonant frequencies respectively,
each smaller microcapsule containing an air bubble and having a
protective wall breakable with an ultrasonic wave of a

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10 corresponding predetermined resonant frequency, each smaller
microcapsule containing inside its protective wall one of two
reacting substances that react with each other when mixed to
thereby cause a coloring reaction and the other of the two
reacting substances being disposed outside the protective wall,
15 the apparatus comprising:

toner image forming means for forming a toner image on an
image carrier by applying the microcapsule toner to the image
carrier in accordance with ORed items of image information
concerned about respective colors or forming a toner image
20 pattern depending on the ORed items of the image information
about the respective colors and for applying the microcapsule
toner to the toner image pattern to thereby form a toner image;

transfer means for transferring the toner image formed on
the image carrier directly or through an intermediate transfer
25 medium to paper;

coloring means for irradiating the toner image formed on the
image carrier with ultrasonic waves of different predetermined
resonant frequencies corresponding to color component items of
the image information, the ultrasonic waves being focused within
30 a width of one pixel in a primary scan direction, between the
time when the toner image was formed on the image carrier and the
time when the toner image was transferred to the paper such that

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the protective wall of a relevant one of the plurality of kinds
of smaller microcapsules of the toner image is broken by the
35 ultrasonic wave of a predetermined resonant frequency to cause
the reacting substances to mix and react with each other to
thereby color the toner image; and

fixing means for fixing the colored toner image to the paper
whereby a color image based upon the toner image is formed on the
40 paper.

Claim 36 (New). The color image forming apparatus according
to claim 35, wherein the toner image forming means comprises:

charging means for charging the image carrier to a
predetermined voltage level;

5 static latent image forming means for forming a static
latent image of a voltage level pattern in accordance with image
information on the image carrier charged by the charging means;
and

developing means for applying the microcapsule toner to the
10 latent image formed on the image carrier.

Claim 37 (New). The color image forming apparatus according
to claim 36, wherein the coloring means is disposed at a position
where it colors the toner image between the development by the

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developing means and the transfer of the toner image by the
5 transferring means.

Claim 38 (New). The color image forming apparatus according
to claim 35, wherein the transferring means comprises
intermediate transfer means for transferring the toner image on
the image carrier to an intermediate transfer medium, and the
5 coloring means is disposed at a position where it colors the
toner image transferred to the intermediate transfer medium.

Claim 39 (New). The color image forming apparatus according
to claim 38, wherein the coloring means irradiates the toner
image transferred to the intermediate transfer medium with an
ultrasonic wave of a predetermined resonant frequency from the
5 side of the toner image.

Claim 40 (New). The color image forming apparatus according
to claim 39, wherein the coloring means irradiates the
transferred toner image with the ultrasonic wave of the
predetermined frequency through an ultrasonic transmission
5 material of a liquid- or solid-phase material and not through a
gas phase material.

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Claim 41 (New). The color image forming apparatus according to claim 35, wherein the coloring means comprises an ultrasonic line head.

Claim 42 (New). The color image forming apparatus according to claim 41, wherein the ultrasonic line head comprises a multiplicity of ultrasonic elements arranged in a primary scan direction and supplied with ultrasonic output signals based upon
5 image information from a plurality of individual applying electrodes to thereby irradiate the plurality of kinds of smaller microcapsules with ultrasonic waves of different resonant frequencies corresponding to the respective color component items of the image information.

Claim 43 (New). The color image forming apparatus according to claim 42, wherein those of the plurality of ultrasonic elements disposed in any adjacent limited range of each side of any particular ultrasonic element produce respective ultrasonic
5 waves so as to be focused at the same timing on the same position as the ultrasonic waves produced by the particular ultrasonic element are focused.

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Claim 44 (New). The color image forming apparatus according to claim 43, wherein the production of the respective ultrasonic waves so as to be focused at the same timing on the same position is performed by sequentially shifting the timing of outputting
5 the ultrasonic waves based upon the distance between the focusing position and each of the ultrasonic elements.

Claim 45 (New). The color image forming apparatus according to claim 42, wherein the ultrasonic element comprises a piezoelectric element.